Previous Office Action

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/909,112	07/19/2001	Joyce S. Oey Hewett	2000.089100/TT4642	1003

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WILLIAMS, MORGAN & AMERSON, P.C.
10333 RICHMOND, SUITE 1100
HOUSTON, TX 77042

EXAMINER
UMEZ ERONINI, LYNETTE T

ART UNIT	PAPER NUMBER
1765	

DATE MAILED: 07/08/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	09/909,112	OEY HEWETT ET AL.
	Examiner	Art Unit
	Lynette T. Umez-Eronini	1765

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on ______ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-51 is/are pending in the application.

4a) Of the above claim(s) 35-51 is/are withdrawn from consideration.

5)☐ Claim(s) ______ is/are allowed.

6)☒ Claim(s) 1-34 is/are rejected.

7)☐ Claim(s) ______ is/are objected to.

8)☒ Claim(s) 35-51 are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on ______ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on ______ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. ______ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) ______ .
4) ☐ Interview Summary (PTO-413) Paper No(s). ______ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Election/Restrictions

1. Applicant's election of claims 1-34 in Paper No. 6 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1-26 are rejected under 35 U.S.C. 102(b) as being anticipated by Muraka et al. (US 5,637,185).

Murarka teaches, "A system for performing chemical mechanical planarization for a semiconductor wafer includes a chemical mechanical polishing system including a chemical mechanical polishing slurry". (Abstract). "Substrates used for polishing were . . . silicon wafers" (column 10, lines 39-40). "A thin metal liner film . . . was sputter deposited . . . followed by a . . . thick copper film . . . Both annealed and unannealed copper films were polished" (column 10, lines 46-53 and column 5, lines 1-9). The aforementioned reads on,

A method, comprising:

providing a substrate having a metal layer formed thereabove;

performing a chemical mechanical polishing process on said layer of metal in the presence of a polishing slurry;

Murarka, further teaches, "Changes in the measured electrochemical potential slurry during processing indicate the stage of the CMP process, as material is abraded from the surface of a layer being polished, and as the concentrations of abraded material in the slurry change" (column 9, lines 13-17). Murarka shows in equation (3), a modified form of the Nerst equation, which shows the relationship between the electrode potential and concentration of copper (column 10, lines 24-26), which reads on,

measuring at least a concentration of a material comprising said metal layer in said polishing slurry used during said polishing process after at least some of said polishing process has been performed.

Murarka teaches, " . . . the composition of the slurry in the region proximate the wafer changes during polishing. For example, when polishing a copper layer, the concentration of copper ions . . . in the slurry will change during polishing, initially increasing, and then decreasing as the copper material is removed and the underlying surface is reached" (column 8, lines 7-14), which provides evidence that the copper (metal) ion concentration in the slurry varies as the copper layer is removed from the surface of a wafer. Since it is well known in the art that a layer of material is measured in term of length (thickness), then using Muraka's method of measuring the metal

concentration that varies as the metal layer is polished from the surface of a metal layer would inherently result in,

determining a thickness of said layer of metal removed during said polishing process based upon at least said measured concentration of said material (same as applicant's copper) comprising said metal layer, **as in claims 1, 11, and 20.**

Murarka teaches, " . . . a much wider range of film materials and process conditions (i.e., pressure, rotational velocities, slurry compositions, slurry delivery and flow rates, etc.) can also be used in accordance with the present invention" (column 9, lines 26-30) and "CMP system can also include control means **64** for receiving and analyzing data received from end point detector means **B**. Control means **B** is capable of generating signals for controlling the operation parameters of the system in response to the data received" (column 8, lines 57-61) which reads on, adjusting at least one parameter of said polishing process based upon said determined thickness of said layer of metal removed during said polishing process, **in claims 2, 12, and 21**.

Murarka teaches, " . . . 250 ml/min were delivered during polishing" (column 11, lines 59-61) and " . . . shows that the potential measurement may be used to monitor the progress of the polishing and predict the polish rate, which makes this invention useful as an in situ process monitor" (column 13, lines 7-12), which reads on measuring a volume of said polishing slurry during said polishing process, **in claims 3, 13, and 22**; and measuring a volume of a material said polishing slurry used during said polishing

process comprises measuring a volume of a said polishing slurry during said polishing process using a volumetric meter, **in claim 8, 17, and 26**.

It is known in the art that the amount of slurry can be expressed in terms of concentration and volume. Murarka has established the amount of metal in a polishing slurry varies as the metal is removed from a layer (see column 8, lines 7-14), which provides evidence for measuring the concentration of a material comprising a metal in the polishing slurry. Similarly one can express the amount of slurry in terms of volume and measure the electrode potential of a give volume of slurry. Based upon the amount of the electrode potential obtained, one can find the corresponding length (thickness) of metal removed from the substrate during polishing and prepare a calibration curve of or find a correlation using a least square fit between the volume and thickness of metal removed, which can be used in formulating an empirical equation that shows the relationship between volume of slurry and thickness removed. By comparison of the calibration curve and by solving an empirical equation, thickness of the metal material removed can be determined. Hence, the aforementioned reads on,

calculating a thickness of said layer of metal removed during said polishing process based upon at least the measured volume of said polishing slurry used during said polishing operation, **in claims 4, 14, and 23**;

calculating a thickness of said layer of metal removed during said polishing process based upon at least the measured volume of said polishing slurry used during

said polishing operation and said measured concentration of said material comprising said metal layer, **in claim 5, 15, and 24**;

wherein said step of determining a thickness of said layer of metal removed during said polishing process comprises accessing a model comprised of data correlating said measured concentration of said material comprising said layer of metal and a thickness of a layer of material comprised of the same material as said layer of meat, **in claims 9 and 18**;

calculating said layer of metal removed during said polishing process based upon at least said measured concentration, **in clam 10**;

wherein said step of determining a thickness of said layer of metal removed during said polishing process comprises calculating a thickness of said layer of metal removed during said polishing process based upon at least said measured concentration, **in claim 19**.

Murarka teaches, "The voltmeter records changes in the electrochemical potential of the slurry during processing as measured by the measurement electrode relative to the reference electrochemical potential measurement of the slurry prior to entering the system" (column 3, lines 34-38), which reads on measuring a concentration of a material comprising said metal layer comprises measuring a concentration of a material comprising said metal layer using a concentration monitor, **in claim 7, 16, and 25**.

4. Claims 27-29 are rejected under 35 U.S.C. 102(b) as being anticipated by Muraka et al. (US '185).

As pertaining to claims 27 and 29, Murarka teaches, "A system for performing chemical mechanical planarization for a semiconductor wafer includes a chemical mechanical polishing system including a chemical mechanical polishing slurry" (Abstract). "Substrates used for polishing were . . . silicon wafers" (column 10, lines 39-40). "A thin metal liner film . . . was sputter deposited . . . followed by a . . . thick copper film . . . Both annealed and unannealed copper films were polished" (column 10, lines 46-53 and column 5, lines 1-9). The aforementioned reads on,

A method, comprising:

providing a substrate having a metal layer comprised of copper formed thereabove;

performing a chemical mechanical polishing process on said layer of metal in the presence of a polishing slurry;

Murarka, further teaches, "Changes in the measured electrochemical potential slurry during processing indicate the stage of the CMP process, as material is abraded from the surface of a layer being polished, and as the concentrations of abraded material in the slurry change" (column 9, lines 13-17). Murarka shows in equation (3), a modified form of the Nerst equation, which shows the relationship between the electrode potential and concentration of copper (column 10, lines 24-26), which reads on

measuring at least a concentration of copper in said polishing slurry used during said polishing process after at least some of said polishing process has been performed.

Murarka teaches, " . . . the composition of the slurry in the region proximate the wafer changes during polishing. For example, when polishing a copper layer, the concentration of copper ions . . . in the slurry will change during polishing, initially increasing, and then decreasing as the copper material is removed and the underlying surface is reached" (column 8, lines 7-14), which provides evidence that the copper (metal) ion concentration in the slurry varies as the copper layer is removed from the surface of a wafer. Since it is well known in the art that a layer of material is measured in term of length (thickness), then one can express the concentration of copper remov d from the layer in terms of the electrode potential of copper in slurry during polishing. Based upon the value of the electrode potential obtained, one can find the corresponding length (thickness) of copper removed from the substrate during polishing and prepare a calibration curve of or find a correlation using a least square fit between the concentration of copper and thickness of metal removed, which can be used in formulating an empirical equation that shows the relationship between volume of slurry and thickness removed. By comparison of the calibration curve and by solving an empirical equation, thickness of the metal material removed can be determined. Hence, the said aforementioned reads on,

calculating a thickness of said layer of metal removed during said polishing process based upon at least the measured volume of said measured concentration of copper; and

determining a thickness of said layer of metal removed during said polishing process by accessing a model comprised of data correlating said measured concentration of copper and a thickness of a layer of copper.

Murarka teaches, " . . . a much wider range of film materials and process conditions (i.e., pressure, rotational velocities, slurry compositions, slurry delivery and flow rates, etc.) can also be used in accordance with the present invention" (column 9, lines 26-30) and "CMP system can also include control means **64** for receiving and analyzing data received form end point detector means **B**. Control means **B** is capable of generating signals for controlling the operation parameters of the system in response to the data received" (column 8, lines 57-61) which reads on, adjusting at least one parameter of said polishing process based upon said determined thickness of said layer of metal removed during said polishing process, **in claim 28**.

5. Claims 30-34 are rejected under 35 U.S.C. 102(b) as being anticipated by Murarka et al. (US '185).

As pertaining to claims 30, 32, 33, and 34, Murarka teaches, "A system for performing chemical mechanical planarization for a semiconductor wafer includes a chemical mechanical polishing system including a chemical mechanical polishing slurry"

(Abstract). "Substrates used for polishing were . . . silicon wafers" (column 10, lines 39-40). "A thin metal liner film . . . was sputter deposited . . . followed by a . . . thick copper film . . . Both annealed and unannealed copper films were polished" (column 10, lines 46-53 and column 5, lines 1-9). The aforementioned reads on,

A method, comprising:

providing a substrate having a metal layer comprised of copper formed thereabove; and

performing a chemical mechanical polishing process on said layer of metal in the presence of a polishing slurry.

Murarka teaches, "Approximately 150 ml of slurry was delivered to the pad before polishing began and 250 ml/min were delivered during polishing" (column 11, lines 59-61) and " . . . shows that the potential measurement may be used to monitor the progress of the polishing and predict the polish rate, which makes this invention useful as an in situ process monitor" (column 13, lines 7-12), which read on,

measuring a volume of said polishing slurry used during said polishing process after at least some of said polishing process has been performed.

Murarka, further teaches, "Changes in the measured electrochemical potential slurry during processing indicate the stage of the CMP process, as material is abraded from the surface of a layer being polished, and as the concentrations of abraded material in the slurry change" (column 9, lines 13-17). Murarka shows in equation (3), a modified from of the Nerst equation, which shows the relationship between the electrode potential and concentration of copper (column 10, lines 24-26). It is known in

the art that the amount of slurry can be expressed in terms of concentration and volume. Murarka has established the amount of metal in a polishing slurry varies as the metal is removed from a layer in column 8, lines 7-14, which further provides evidence for measuring the concentration of a material comprising a metal in the polishing slurry. Similarly one can express the amount of slurry in terms of volume and measure the electrode potential of a give volume of slurry. Based upon the amount of the electrode potential obtained, one can find the corresponding length (thickness) of metal removed from the substrate during polishing and prepare a calibration curve of or find a correlation using a least square fit between the volume and thickness of metal removed, which can be used in writing an empirical equation that shows the relationship between volume of slurry and thickness removed. By comparison of the calibration curve or by solving an empirical equation, thickness of the metal material removed can be determined. Hence the above aforementioned reads on,

calculating a thickness of said layer of metal removed during said polishing process based upon at least said measured volume of polishing slurry and said measured concentration of copper.

Murarka teaches, " . . . a much wider range of film materials and process conditions (i.e., pressure, rotational velocities, slurry compositions, slurry delivery and flow rates, etc.) can also be used in accordance with the present invention" (column 9, lines 26-30) and "CMP system can also include control means **64** for receiving and analyzing data received from end point detector means **B**. Control means **B** is capable

of generating signals for controlling the operation parameters of the system in response to the data received" (column 8, lines 57-61) which reads on, adjusting at least one parameter of said polishing process based upon said determined thickness of said layer of metal removed during said polishing process, **in claim 31**.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 703-306-9074. The examiner is normally unavailable on the First Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on 703-308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

ltue
June 28, 2003

ROBERT KUNEMUND
PRIMARY EXAMINER